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Supplementary materials for

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1 Theoretical Basis and Model Construction of Bionic Anti-interference

1.1 Rate functions of the Hodgkin–Huxley gating variables

The rate functions of the gating variables in the Hodgkin–Huxley model are given as follows:

$$\alpha_{\mathrm{m}}=\frac{0.1\times(V+40)}{1-\exp\left(-(V+40)/10\right)} \tag{S1}$$

$$\beta_{m}=4\exp\left(-(V+65)/18\right) \tag{S2}$$

$$\alpha_{\mathrm{n}}=\frac{0.01\times(V+55)}{1-\exp\left(-(V+55)/10\right)} \tag{S3}$$

$$\beta_{\mathrm{n}}=0.125\exp\left(-(V+65)/80\right) \tag{S4}$$

$$\alpha_{\mathrm{h}}=0.07\exp\left(-(V+65)/20\right) \tag{S5}$$

$$\beta_{\mathrm{h}}=\frac{1}{\exp\left(-(V+35)/10\right)+1} \tag{S6}$$

1.2 The small-world network

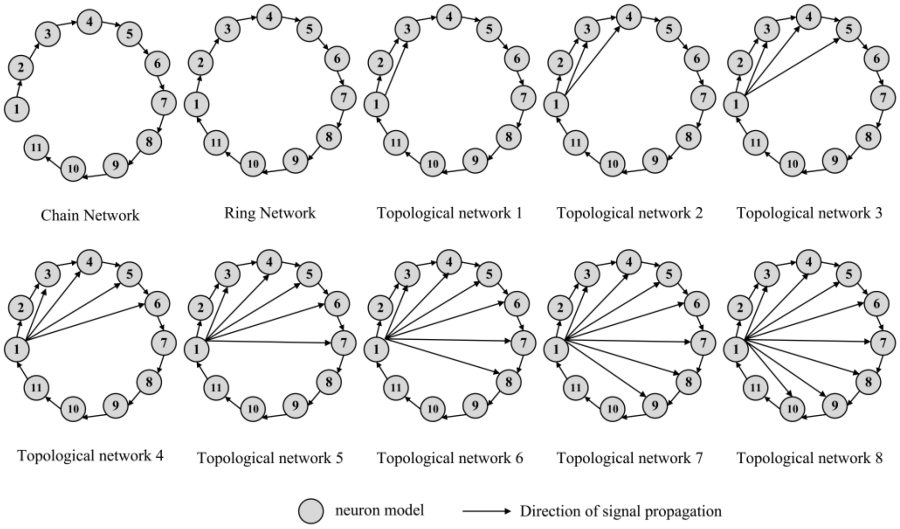


Fig. S1 Neural network topology.

2 Simulation results

2.1 HH neuron system generator for digital signal processing (DSP) modeling diagram.

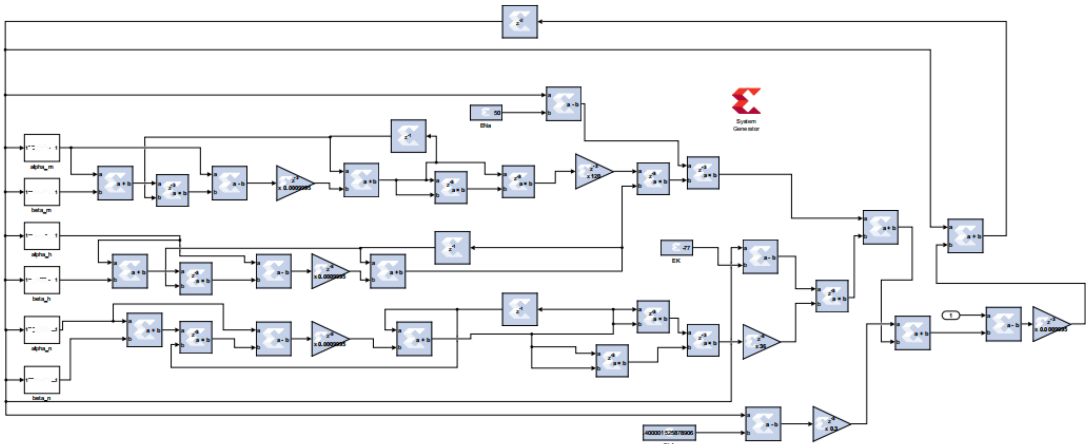


Fig. S2 HH neuron system generator for digital signal processing (DSP) modeling diagram.

2.2 IZH neuron system generator for DSP modeling diagram.

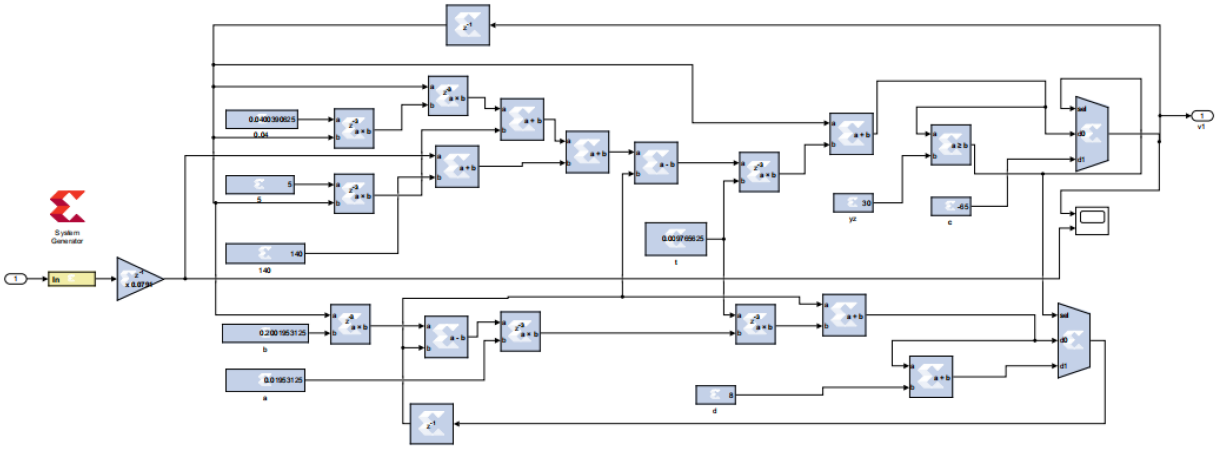


Fig. S3 IZH neuron system generator for DSP modeling diagram.

2.3 Neural model synchronous waveform

Representative synchronization waveforms are provided to show neuron-to-neuron phase alignment details. The quantitative synchronization index is retained in the main text.

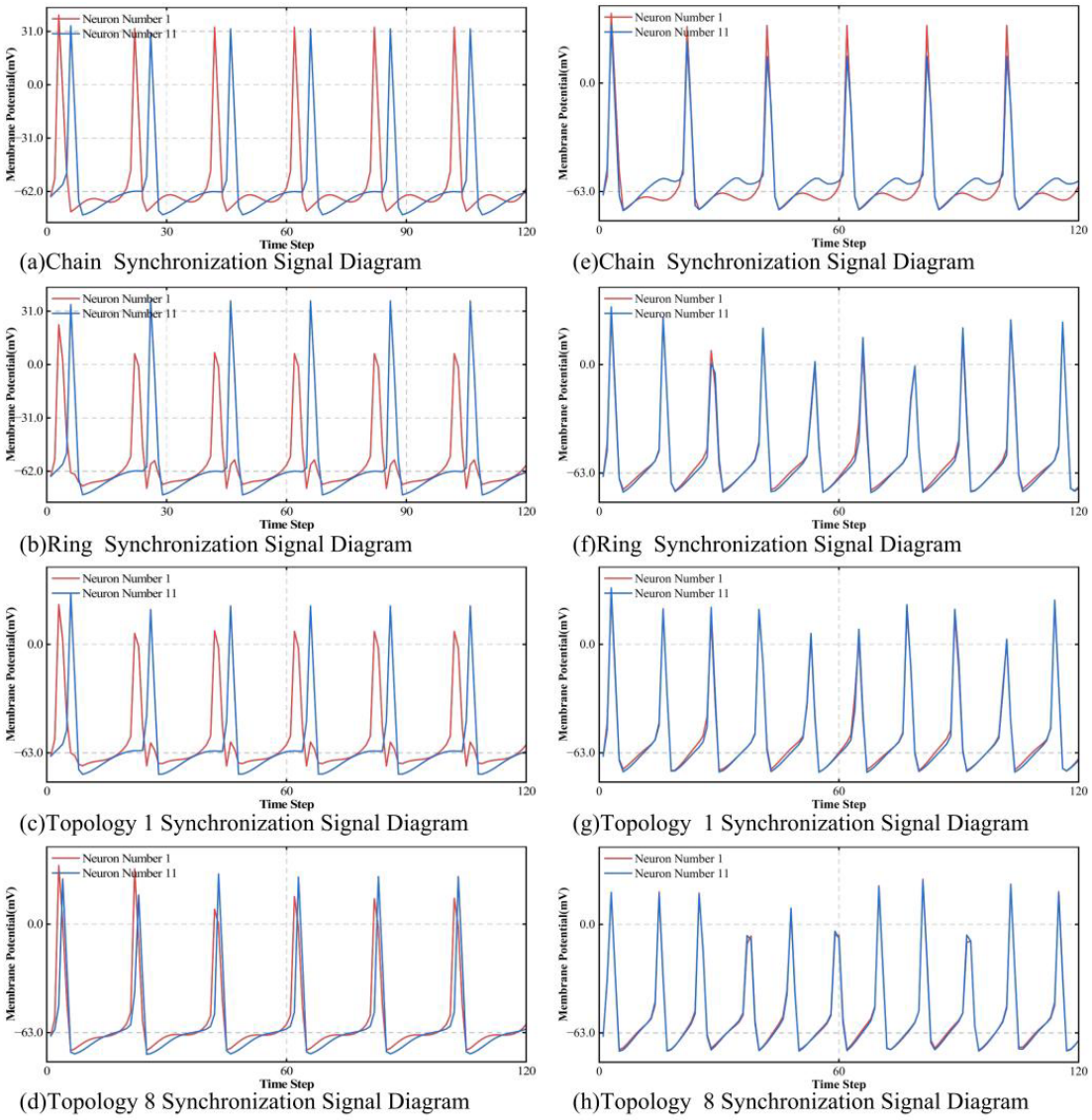


Fig. S4 HH model simulation of synchronous situation action potential diagram (a–d show the waveforms of the topological potentials for G_s = 1 mS/cm^2; e–h show the waveforms of the topological potentials for G_s =5 mS/cm^2).

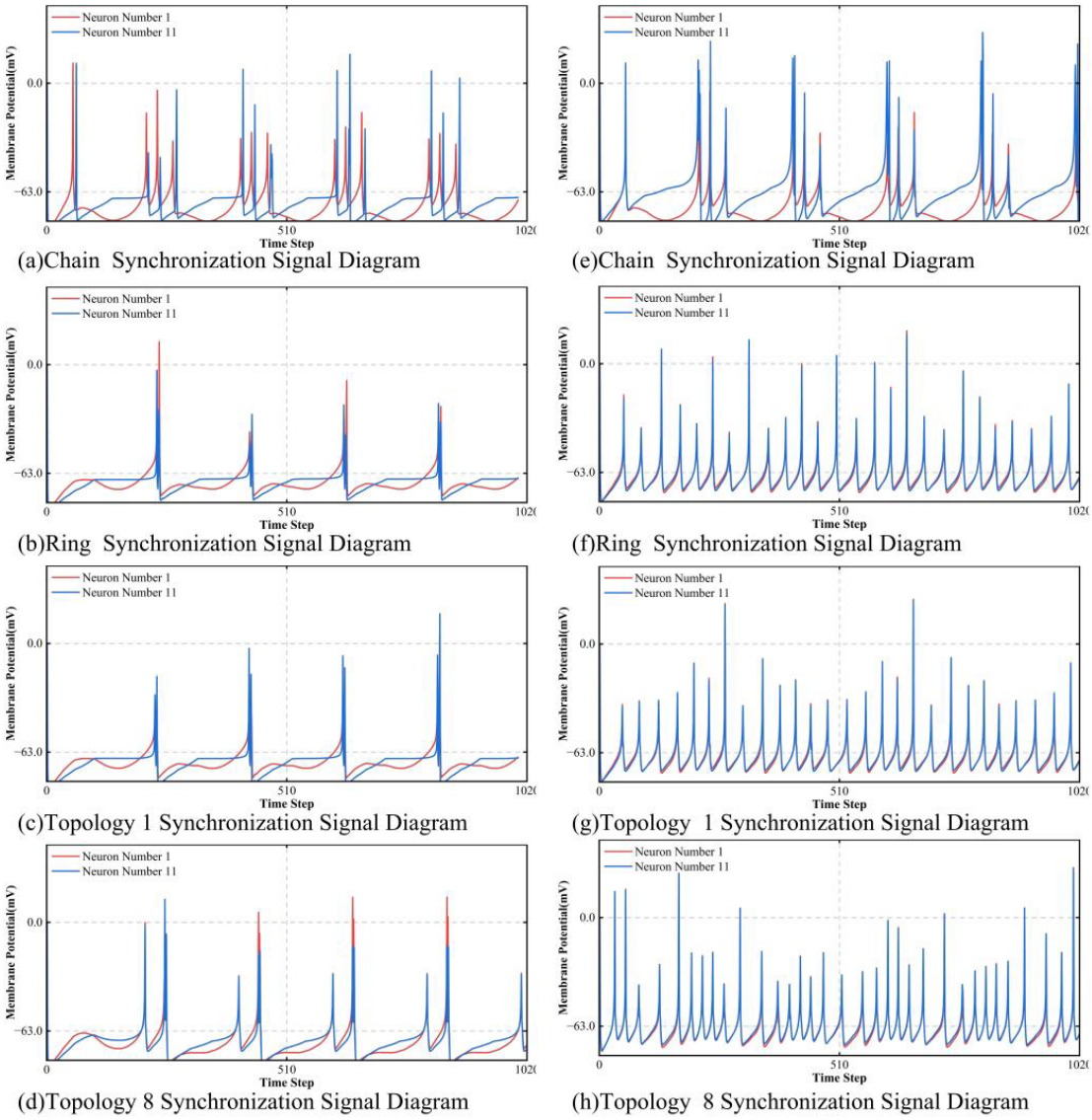


Fig. S5 IZH model simulation of synchronous situation action potential diagram (a–d show the waveforms of the topological potentials for G_s = 1 mS/cm^2; e–h show the waveforms of the topological potentials for G_s = 5 mS/cm^2).

2.4 Additional synchronization and activity-energy results

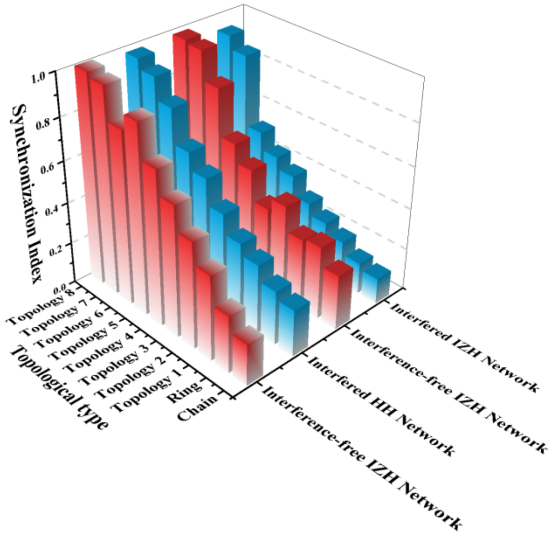


Fig. S6 Synchronization index of each neural network with and without interference (G_s = 1 mS/cm^2).

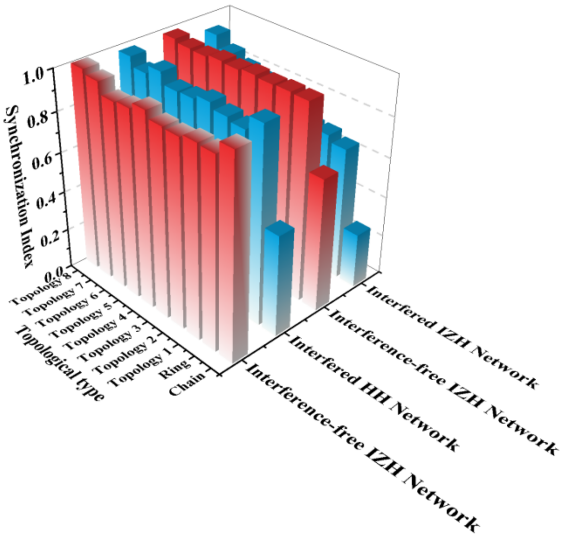


Fig. S7 Synchronization index of each neural network with and without interference (G_s = 5 mS/cm^2).

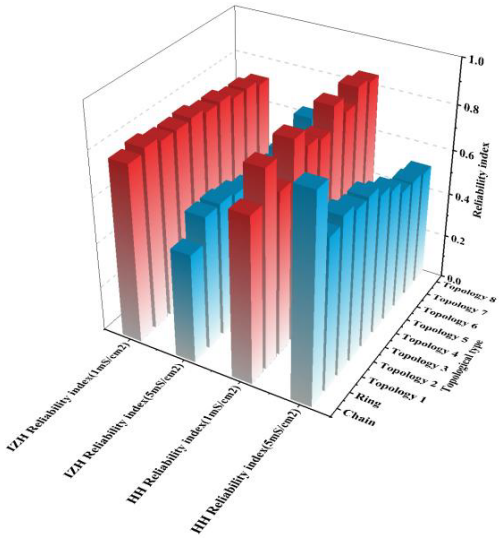


Fig. S8 Various reliability indicators of neural networks.

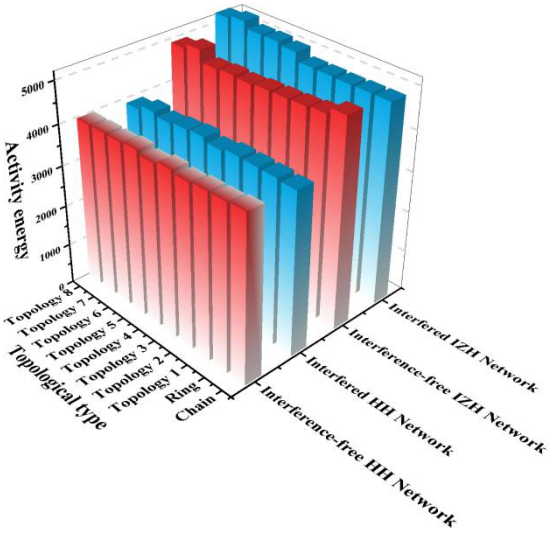


Fig. S9 Activity energy of each neural network with and without interference (G_s = 1 mS/cm^2).

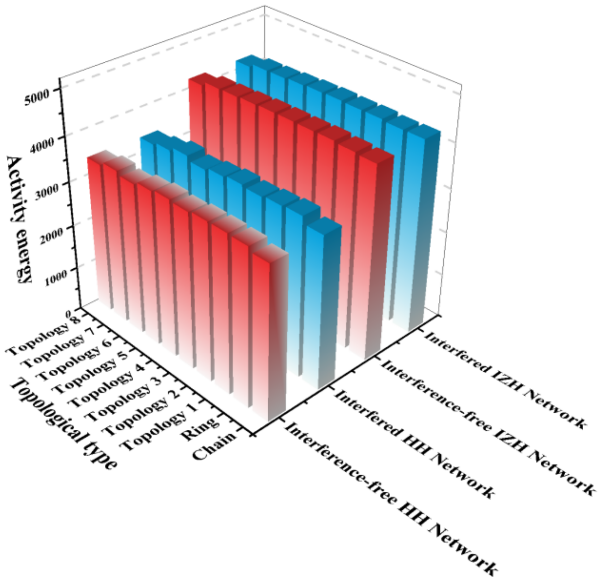


Fig. S10 Activity energy of each neural network with and without interference (G_s = 5 mS/cm^2).

3 Hardware implementation of synchronous neural network circuits

3.1 Hardware Design Process

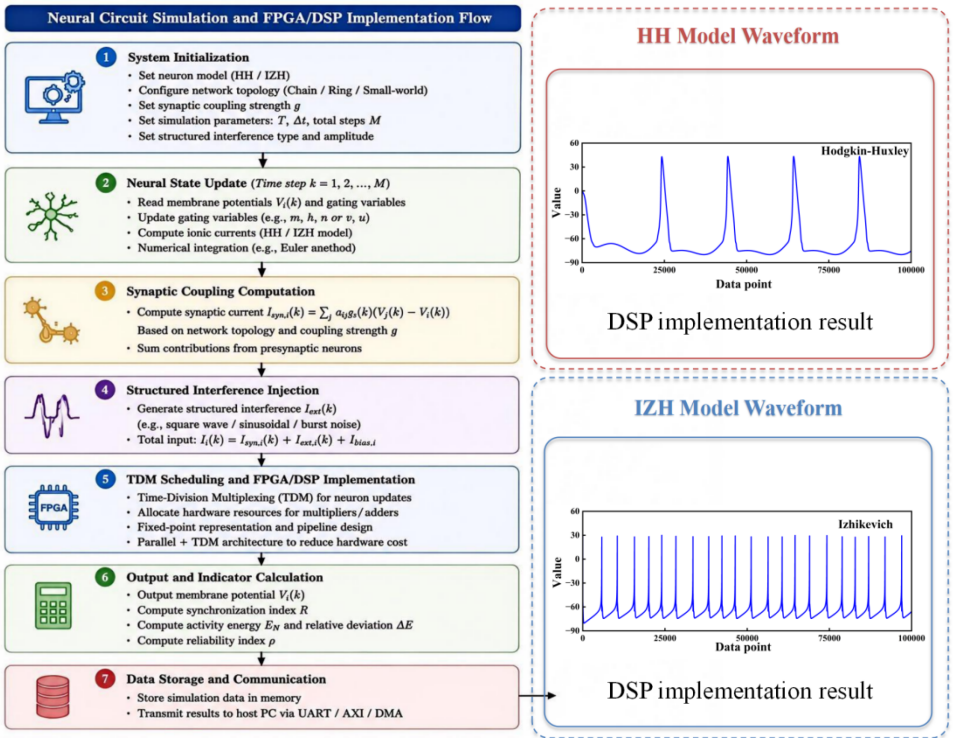


Fig. S11 Hardware design flowchart.

3.2 Hardware implementation results

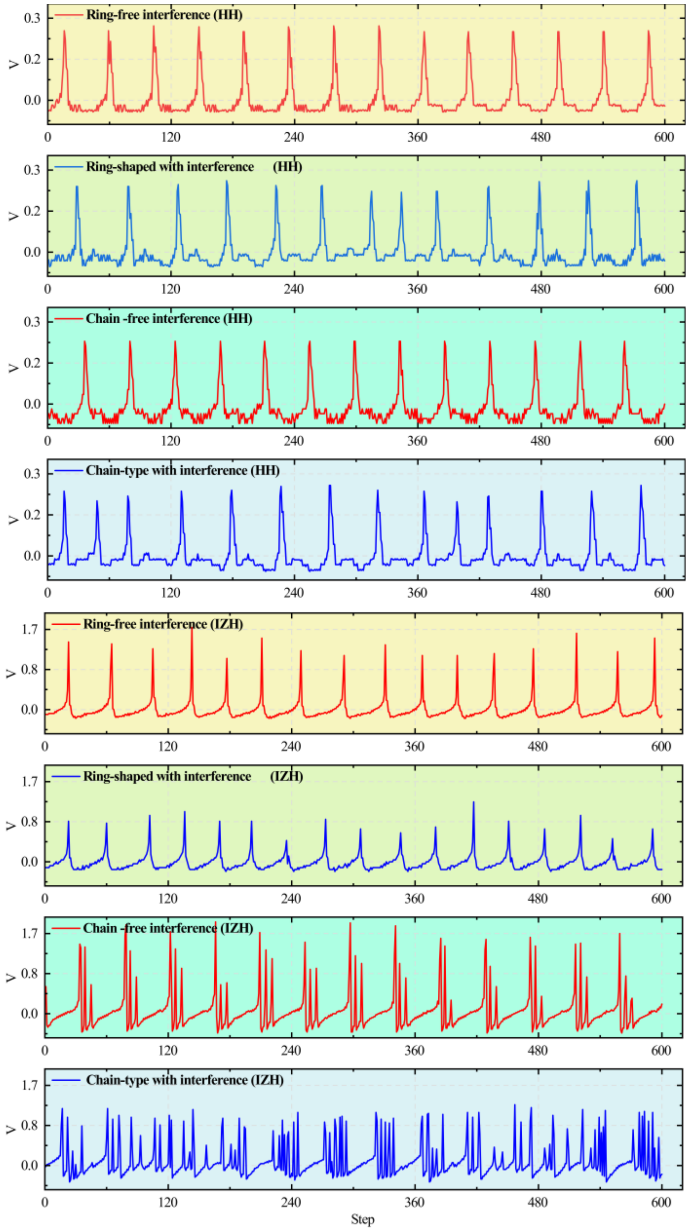


Fig. S12. Action potential diagrams of chain- and ring-type HH and IZH model network circuits in the absence and presence of signal interference.